Terrestrial vertebrate survey in the coastal wetlands surrounding Cairns International Airport, North Queensland

A. S. Kutt[1]

[1]Australian Centre for Tropical Freshwater Research, James Cook University, Townsville, Queensland 4811

ABSTRACT

A short terrestrial vertebrate survey was conducted in November 1994 in the coastal wetlands surrounding the Cairns International Airport. Six discrete habitat types were recorded for the study area: sand ridge woodland; beach dune low woodland/shrubland; mangrove-intertidal; eucalyptus woodland; claypan/saltmarsh and disturbed habitat. The survey utilized direct and indirect sampling techniques including live-mammal trapping, hair-tubing, spotlighting, ultrasonic bat detection, bird census, active searching and predator scat collection. A total of 129 terrestrial vertebrate species (seven amphibians, 23 reptiles, 85 birds, seven non-volant mammals, seven bats) were recorded including three amphibians and seven reptile species from the records of the Queensland Museum. The diversity of the fauna assemblages and habitats recorded are discussed and number of important environmental features of coastal wetland habitats for terrestrial vertebrates are identified.

INTRODUCTION

Mangroves and other intertidal habitats represent an interface between aquatic and terrestrial environments (Macnae 1966). Characteristic vertebrate fauna communities derived from both these ecosystems utilize a variety of habitats within coastal wetlands, with only a few species being entirely obligate to any one habitat type (Hutchings and Saenger 1987). Though mangroves tend to dominate the vegetation in northern tropical coastal zones, mosaics occur comprising mudflats, seagrasses, saltmarsh, beach dunes, woodlands and closed forest habitat. Diverse and abundant fauna assemblages are supported in these heterogeneic environments, representing all vertebrate classes (Hutchings and Recher 1982; Hutchings and Saenger 1987).

Many terrestrial vertebrates groups are often overlooked in coastal wetland surveys, with effort usually being directed towards vegetation, invertebrate and intertidal bird assemblages (Graham *et al.* 1975; Hutchings and Saenger 1987; Lane 1987; TIMP 1992). Graham *et al.* (1975) undertook a preliminary survey of wetland biota in the Cairns area, but devoted only three paragraphs to vertebrate fauna, identifying flying foxes, Crocodiles *Crocodylus porosus* and an "abundant bird life" as being present within their study area. Though in subsequent years, the shorebirds of the Cairns foreshore and surrounding intertidal areas have been extensively studied and monitored (Lane 1987; ESS 1989; TIMP 1992), other terrestrial taxa have not. The aim of this survey is to survey and describe the terrestrial vertebrates and habitats present within the coastal wetlands surrounding the Cairns International Airport, with particular reference to less frequently studied species groups. This study formed part of a larger environmental baseline survey of the coastal wetlands surrounding Cairns International Airport (CIA), commissioned by the Cairns Port Authority (CPA) (Kutt *et al.* 1995).

STUDY AREA

The CPA is a corporate body that owns the CIA and holds freehold title for the surrounding land. The airport, situated 5 km north of the Cairns city centre, is built on reclaimed tidal wetlands and is surrounded by a complex mosaic of coastal wetland habitats. These wetlands, including Redden Island, cover approximately 366 ha, and represent the study area for this survey (Fig. 1, Fig. 3). This forms part of a larger biogeographic region of approximately 4 500 ha known as Trinity Inlet. This inlet represents a system of marine, intertidal, wetland and terrestrial vegetation communities and habitats including mangroves, seagrass beds, claypans, mudflats, sand ridges and freshwater swamps (TIMP 1992).

Six discrete habitat types were recorded for the study area and their distribution is indicated in Figure 2. These generally correspond to the vegetation communities identified for the study area (McDonald 1984; Boto and Robertson 1989; Kutt *et al.* 1995) and are described below.

Sand Ridge Woodland Habitat (S)

This habitat corresponds to the tall 18 m *Melaleuca leucadendra* woodland and closed forest vegetation communities recorded on the sand dune ridges. These communities also typically contain *Acacia crassicarpa, Pleiogynum timorense, Canarium australanium, Randia fitzalanii* in the

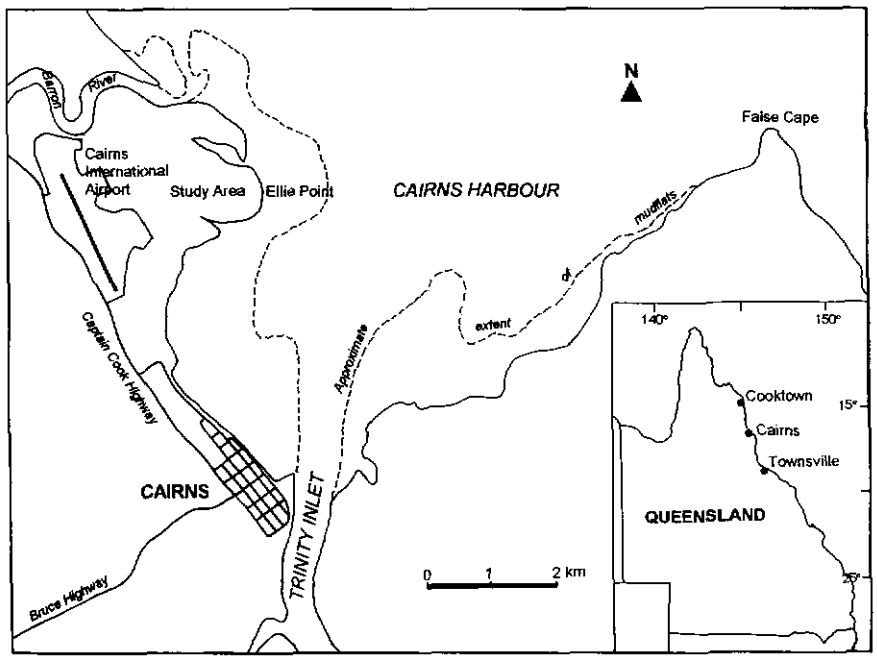

Figure 1. Location of Cairns International Airport study area.

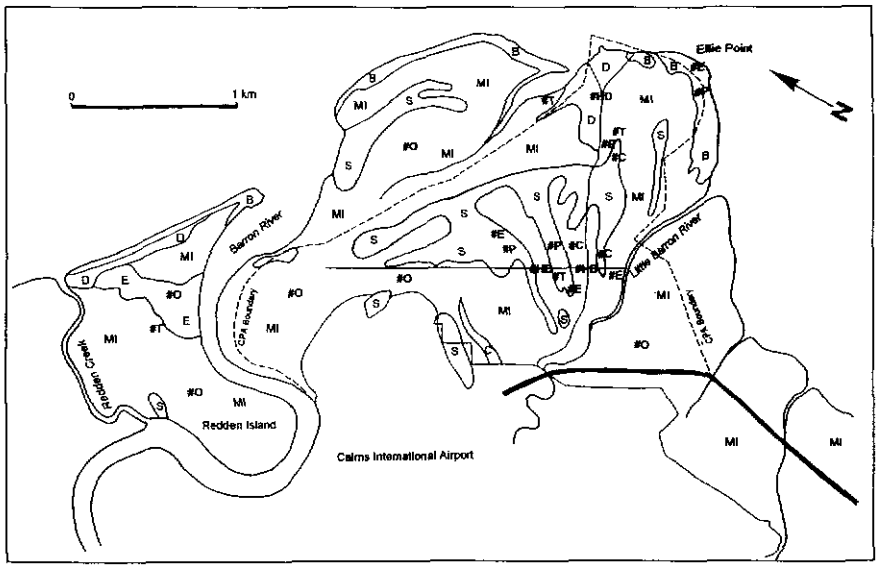

Figure 2. Terrestrial vertebrate fauna survey locations and distribution of habitat types. #E indicate elliot trapping sites, #P indicate pitfall trapping sites, #C indicate cage trapping sites, #T indicate hair-tubing sites and #HD indicate harp trapping and detecting sites. #O indicates approximate locations of active searches and spotlighting walks. Labels for habitat types correspond to those described in the text (see Study Area).

sub-canopy, an understorey up to 5 m of *Cupaniopsis anacardioides, Polyscias elegans, Ficus oppsita, Pandanus* sp., *Mimusops elengi, Persoonia falcata, Schefflera actinophylla, Morinda citrifolia, Terminalia meulleri* and a shrub/ground layer of *Urena lobata, Imperata cylindrica, Alyxia obtusifolia, Dianella* sp. and *Dendrobium* spp. Vines such as *Jasminum volubile* and *Flagellaria indica* are prominent in these communities.

Beach Dune Low Woodland/Shrubland Habitat (B)

This habitat corresponds to the *Casuarina equisetifolia* var. *incana* low open forest to low woodland on and immediately inland of the beach foredune. This community also typically contains *Acacia crassicarpa, A. polystachya, Alphitonia excelsa, Canarium australianum, Terminalia* spp. in the canopy, a poorly developed shrub layer to 5 m of

Figure. 3. An aerial view of the Cairns International Airport and surrounding wetlands. Clearly visible is the complex mosaic of coastal habitat types, seagrass beds, intertidal mudflats, beaches and beach dunes; mangroves; sand dune ridges; closed forests; eucalyptus woodlands; and claypans. Such an array of habitats close to an urban environment provides a valuable refuge for a diverse fauna assemblage. Photo reproduced with the permission of the Cairns Port Authority.

Clerodendrum inerme, Exocarpus latifolius, Myrtella obtusa, Cupaniopsis anacarioides and a ground cover of *Imperata cylindrica, Panicum maximum* and *Sporobolus virginicus.*

Mangrove-intertidal Habitat (MI)

This habitat corresponds to all the mangrove communities (mixed forest/*Ceriops decandra* dominant, *Rhizophora* spp. dominant, *Bruguiera*

parviflora dominant, *Avicennia marina* dominant, *Ceriops decandra/C. tagal* dominant, mixed forest/ *C. tagal* dominant, *Xylocarpus* spp./*B. parviflora* dominant) and associated mudflat and non-vegetated sand spits and dunes recorded in the study area.

Eucalyptus Woodland Habitat (E)

This habitat corresponds to the tall 16–18 m open *Eucalyptus tessellaris* woodland community on Redden Island. This community also typically contains *E. intermedia, E. tereticornis* and *M. leucadendra* in the canopy layer, an understorey 8–10 m tall of *Acacia crassicarpa, Grevillea glauca, Lophostemon suaveolens* and a shrub layer 2–5 m of *Acacia flavescens, Pandanus* sp. *Planchonia careya, Alyxia* spp. and *Myrtella obtusa.*

Claypan/Saltmarsh Habitat (C) and Disturbed Habitat (D)

These two habitats correspond respectively to all saltmarsh and claypan sites and the the tracks, survey lines and areas cleared of native vegetation. Claypan/saltmarsh habitat was not surveyed during the present study.

METHODS

Vertebrates were surveyed between the 25–30 November 1994. Survey techniques used and total effort were: elliott trapping (275 trap-nights); cage trapping (39 trap-nights); harp trapping (four trap-nights); hair-tubing (180 tube-nights); pitfall trapping (50 trap-nights); spotlighting (six spotlight-hours); and ultrasonic bat detection (three hours). Spotlighting, bat detection, bird census, active searching and predator scat collection were conducted opportunistically throughout the study area. Trapping locations are mapped in Figure 2. Additional records for the study area were obtained from the Queensland Museum database.

Habitat types for the study area were delineated according to existing vegetation maps and descriptions for the study area (McDonald 1984; Boto and Robertson 1989; Kutt *et al.* 1995). A habitat type is formed by a particular combination of floristic and structural attributes of vegetation and correspond broadly to vegetation communities. These attributes may provide a unique set of resources that can support characteristic fauna association. It should be noted that habitat type boundaries are largely artificial, as many species move between types or utilize more than one habitat according to life history patterns or changing environmental conditions.

National and state conservation status for species is assessed using published lists recognized by the scientific community and government bodies. For national significance, Schedule 2 of the (Commonwealth) *Endangered Species Act 1992* and the Australian Nature Conservation Agency Action Plans for vertebrate fauna are used. Currently only five Action Plans are published: marsupials and monotremes (Kennedy 1993); reptiles (Cogger *et al.* 1993); shorebirds (Watkins 1993); birds (Garnett 1992) and rodents (Lee 1995). The Action Plans for bats and frogs are currently in preparation. For state significance, conservation status levels and species listed in the Queensland Nature Conservation (wildlife) Regulation 1994 are used.

Nomenclature follows Ingram and Raven (1991) for mammals, Christidis and Boles (1994) for birds, Richards *et al.* (1993) for bats, Cogger (1993) for reptiles and Ingram *et al.* (1993) for amphibians.

RESULTS

A total of 127 terrestrial vertebrate species, comprising seven amphibians, 23 reptiles, 83 birds, seven non-volant mammals and seven bats, were recorded from the study area. This includes three amphibians and seven reptiles only recorded from the Queensland Museum database. A full species list is presented in Table 1, including the source of the record, relative abundance and habitat. Relative abundance may be an inexact measure, given the low total sampling effort for some groups such as bats. In this case, a very general tripartite categorization is used to indicate species abundance in the habitats they were found (see Table 1). These measures should not be taken as a reflection of the species' long-term abundance in the study area.

Predator scat, elliott, cage and pitfall trapping results are presented in Table 2. No species were recorded from the hair-tubes. Three species recorded are considered to be of state conservation significance: Beach Stone-curlew (vulnerable), White-rumped Swiftlet (rare), Eastern Curlew (rare) (*Queensland Nature Conservation Act 1994*).

DISCUSSION

The present survey recorded a diverse terrestrial vertebrate assemblage and further survey is likely to increase the number of species recorded. This is perhaps a reflection of the number of habitats, and hence potential available resources, identified for area. A brief discussion of the results according to species groups is provided below. Two limitations for the present survey should be noted. Firstly, it sampled a single season for a short period. Consequently, many seasonal and migratory species, or species more active in particular seasonal conditions (e.g., amphibians during rainfall) may not have been recorded. Secondly, elusive and trap-shy

Table 1. Vertebrate fauna species recorded from the study area, including indication record source, estimated abundance from the survey and habitat species was recorded in. * indicates introduced species. *Record source codes:* E = elliott traps, C = cage traps, P = pitfall traps, D = ultrasonic bat detector, H = harp trap, A = active searching, O = general observation, B = bird census, I = indirect evidence (scats, hairs, remains, diggings), S = spotlighting, QM = Queensland Museum collections database. *Relative abundance codes*: 1 = single record of individual or group, 2 = uncommon, recorded infrequently and from up to 25–50% of habitats/sites surveyed and 3 = common, recorded frequently and from between 50–100% of habitats/sites surveyed.

FAMILY	SPECIES	COMMON NAME	SOURCE	RELATIVE ABUNDANCE	HABITAT
AMPHIBIANS					
Myobatrachidae	*Limnodynastes convexiusculus*	Marbled Frog	QM	—	E, S
Myobatrachidae	*Limnodynastes ornatus*	Ornate Burrowing Frog	P	1	S
Hylidae	*Litoria alboguttata*	Greenstripe Frog	S	2	D, S
Hylidae	*Litoria genimaculata*	Green-eyed Treefrog	QM	—	E
Hylidae	*Litoria infrafrenata*	White-lipped Treefrog	QM	—	E, S
Hylidae	*Litoria nasuta*	Striped Rocketfrog	S, O	2	D, S
Bufonidae	*Bufo marinus**	Cane Toad*	S, O	3	ALL
REPTILES					
Gekkonidae	*Gehyra dubia*	House Gecko	A	2	S
Gekkonidae	*Nactus pelagicus*	Pelagic Gecko	P	2	S
Agamidae	*Diporiphora bilineata*	Two-lined Dragon	QM	—	S, E
Varanidae	*Varanus gouldi*	Sand Monitor	O	1	E, D, S
Varanidae	*Varanus varius*	Lace Monitor	O	1	S, D
Scinidae	*Carlia longipes*	Skink	P, A	2	S
Scinidae	*Carlia storri*	Skink	A	2	S
Scinidae	*Carlia vivax*	Skink	P	2	S
Scinidae	*Cryptoblepharus littoralis*	Skink	A	2	S, B
Scinidae	*Cryptoblepharus virgatus*	Skink	A	2	S
Scinidae	*Ctenotus taeniolatus*	Skink	A, P	2	S, B
Scinidae	*Glaphyromorphus pumilus*	Skink	QM	—	S, E
Scinidae	*Lampropholis delicata*	Skink	A	2	S
Scinidae	*Lygisaurus aeratus*	Skink	P, A	2	S
Boidae	*Morelia amethistina*	Amythestine Python	O	1	S, MI
Acrochordidae	*Acrochordus granulatus*	Little File Snake	QM	—	MI
Colubridae	*Tropidonophis mairii*	Keelback Snake	QM	—	MI
Elapidae	*Pseudechis porphyriacus*	Red-bellied Black Snake	O	1	D, S, E
Elapidae	*Rhinoplocephalus nigrescens*	Small-eyed Snake	P	1	S
Hydrophiidae	*Aipysurus duboisii*	Sea Snake	QM	—	MI
Hydrophiidae	*Aipysurus eydouxii*	Sea Snake	QM	—	MI
Hydrophiidae	*Astrotia stokesii*	Sea Snake	QM	—	MI
Hydrophiidae	*Pelamus platurus*	Sea Snake	QM	—	MI
BIRDS					
Megapodiidae	*Megapodius reinwardt*	Orange-footed Scrubfowl	O	1	S, MI
Pelicanidae	*Pelecanus conspicillatus*	Pelican	O	2	MI
Ardeidae	*Egretta novaehollandiae*	White-faced Heron	O	2	MI, B
Ardeidae	*Egretta intermedia*	Intermediate Egret	O	2	MI, B
Ardeidae	*Butorides striatus*	Striated Heron	O	1	MI
Ardeidae	*Ixobrychus flavicollis*	Black Bittern	O	1	MI
Threskiornithidae	*Threskiornis molucca*	Australian White Ibis	O	3	MI, D
Accipitridae	*Pandion haliaetus*	Osprey	O	2	ALL
Accipitridae	*Haliastur indus*	Brahminy Kite	O	2	ALL
Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea-eagle	O	2	ALL
Falconidae	*Falco berigora*	Brown Falcon	O	1	S, E
Scolopacidae	*Numenius madagascariensis*	Eastern Curlew	O	2	MI, B
Scolopacidae	*Numenius phaeopus*	Whimbrel	O	2	MI, B
Scolopacidae	*Limosa lapponica*	Bar-tailed Godwit	O	1	MI
Burhinidae	*Burhinus grallarius*	Bush Stone-curlew	O	2	S, MI
Burhinidae	*Esacus neglectus*	Beach Stone-curlew	O	2	MI, B, D
Haematopodidae	*Haematopus longirostris*	Pied Oystercatcher	O	1	MI
Charadriidae	*Vanellus miles*	Masked Lapwing	O	3	D
Charadriidae	*Charadrius ruficapillus*	Red-capped Plover	O	2	MI
Laridae	*Larus novaehollandiae*	Silver Gull	O	2	MI, B
Laridae	*Sterna nilotica*	Gull-billed Tern	O	2	MI, B
Laridae	*Sterna caspia*	Caspian Tern	O	2	MI, B, D
Laridae	*Sterna hirundo*	Common Tern	O	1	MI, B
Columbidae	*Ptilinopus superbus*	Superb Fruit-dove	B	2	S
Columbidae	*Ptilinopus regina*	Rose-crowned Fruit-dove	B	2	S
Columbidae	*Ducula bicolor*	Pied Imperial-pigeon	B	1	S
Columbidae	*Geopelia striata*	Peaceful Dove	B	3	ALL
Columbidae	*Geopelia humeralis*	Bar-shouldered Dove	B, O	3	E, S
Loriidae	*Trichoglossus haematodus*	Rainbow Lorikeet	B, O	3	S, E
Loriidae	*Cyclopsitta diophthalma*	Double-eyed Fig-parrot	B, O	2	S, E

Table 1 — *continued*

FAMILY	SPECIES	COMMON NAME	SOURCE	RELATIVE ABUNDANCE	HABITAT
BIRDS — *Continued*					
Cuculidae	*Cuculus pallidus*	Pallid Cuckoo	B, O	2	E
Cuculidae	*Cacomantus variolosus*	Brush Cuckoo	B, O	2	E
Cuculidae	*Chrysococcyx basalis*	Horsfields Bronze-cuckoo	B, O	2	MI
Cuculidae	*Chrysococcyx lucidus*	Shining Bronze-cuckoo	B, O	2	MI, S
Cuculidae	*Chrysococcyx minitillus*	Little Bronze-cuckoo	B, O	3	MI
Cuculidae	*Eudynamys scolopacea*	Common Koel	B, O	3	MI, S
Cuculidae	*Scythrops novaehollandiae*	Channel-billed Cuckoo	B, O	2	S
Centropodidae	*Centropus phasianinus*	Pheasant Coucal	B, O	3	S, D
Podargidae	*Podargus papuensis*	Papuan Frogmouth	S	1	MI
Apodidae	*Collocalia spodiopygia*	White-rumped Swiftlet	B, O	3	AERIAL
Apodidae	*Hirundapus caudacutus*	White-throated Needletail	B, O	2	AERIAL
Halcyonidae	*Dacelo novaeguineae*	Laughing Kookaburra	B, O	3	S, D
Halcyonidae	*Todiramphus macleayii*	Forest Kingfisher	B, O	3	S
Halcyonidae	*Halycon chloris*	Collared Kingfisher	B, O	2	MI
Meropidae	*Merops ornatus*	Rainbow Bee-eater	B, O	3	ALL
Coraciidae	*Eurystomus orientalis*	Dollarbird	B, O	3	S
Hirundinidae	*Hirundo neoxena*	Welcome Swallow	B, O	2	AERIAL
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	B, O	2	S, E
Campephagidae	*Coracina papuensis*	White-bellied Cuckoo-shrike	B, O	2	S, E
Campephagidae	*Coracina tenuirostris*	Cicadabird	B, O	2	S, E
Campephagidae	*Lalage leucomela*	Varied Triller	B, O	2	MI
Petroicidae	*Eopsaltria pulverulenta*	Mangove Robin	B, O	1	MI
Dicruridae	*Monarchia trivirgatus*	Spectacled Monarch	B, O	2	S
Dicruridae	*Myiagra cyanoleuca*	Satin Flycatcher	B, O	2	S
Dicruridae	*Myiagra alecto*	Shining Flycatcher	B, O	1	MI, S
Dicruridae	*Myiagra inquieta*	Restless Flycatcher	B, O	2	E
Dicruridae	*Rhipidura leucophrys*	Willie Wagtail	B, O	2	D
Dicruridae	*Artamus leucorhynchus*	Spangled Drongo	B, O	2	S, MI
Dicruridae	*Grallina cyanoleuca*	Magpie-lark	B, O	2	D
Maluridae	*Malurus amabilis*	Lovely Fairy-wren	B, O	2	S, D
Pardalotidae	*Sericornis magnirostris*	Large-billed Scrubwren	B, O	2	MI, S
Pardalotidae	*Gerygone mouki*	Brown Gerygone	B, O	2	MI, S
Pardalotidae	*Gerygone palpebrosa*	Fairy Gerygone	B, O	1	MI, S
Pardalotidae	*Gerygone magnirostris*	Large-billed Gerygone	B, O	2	MI, S
Pardalotidae	*Gerygone levigaster*	Mangrove Gerygone	B, O	2	MI, S
Meliphagidae	*Philemon buceroides*	Helmeted Friarbird	B, O	2	E, MI, S
Meliphagidae	*Melaphagi notata*	Yellow-spotted Honeyeater	B, O	3	S, MI
Meliphagidae	*Melaphagi gracilis*	Graceful Honeyeater	B, O	2	S, MI
Meliphagidae	*Lichenostomus versicolor*	Varied Honeyeater	B, O	1	MI
Meliphagidae	*Melithreptus albogularis*	White-throated Honeyeater	B, O	2	S
Meliphagidae	*Lichmera indistincta*	Brown Honeyeater	B, O	3	MI
Meliphagidae	*Myzomela obscura*	Dusky Honeyeater	B, O	2	MI, S, B
Nectarinidae	*Nectarinia jugularis*	Yellow-bellied Sunbird	B, O	3	MI, S, B
Dicaeidae	*Dicaeum hirundinaceum*	Mistletoebird	B, O	2	S, E
Zosteropidae	*Zosterops lateralis*	Silvereye	B, O	2	MI
Estrildidae	*Taeniopygia bichenovii*	Double-barred Finch	B, O	2	D, S
Sturnidae	*Aplonis metallica*	Metallic Starling	B, O	1	S
Sturnidae	*Acridotheres tristus**	Indian Myna*	B, O	2	D
Oriolidae	*Oriolus flavocinctus*	Yellow Oriole	B, O	2	S
Oriolidae	*Oriolus sagittatus*	Olive-backed Oriole	B, O	2	S
Oriolidae	*Sphecotheres viridis*	Figbird	B, O	2	S, E, MI
Artamidae	*Artamus leucorhynchus*	White-breasted Woodswallow	B, O	2	D, S
Artamidae	*Cracticus quoyi*	Black Butcherbird	B, O	2	MI
MAMMALS					
Canidae	*Canis familiaris**	Domestic Dog*	I	2	D
Emballonuridae	*Taphozous georgianus*	Common Sheath-tailed Bat	D	1	S
Macropodidae	*Macropus agilis*	Agile Wallaby	S, O	2	S, MI
Molossidae	*Mormopterus loriae*	Little Freetail Bat	D	2	MI, S
Muridae	*Hydromys chrysogaster*	Water Rat	O, I	2	MI
Muridae	*Melomys burtoni*	Grassland Melomys	E, I	3	S, B
Muridae	*Uromys caudimaculatus*	White-tailed Rat	C, E	2	S, MI
Petauridae	*Petaurus breviceps*	Sugar Glider	S	1	S
Pteropidae	*Pteropus alecto*	Black Flying-fox	S	2	MI, S
Tachyglossidae	*Tachyglossus aculeatus*	Echidna	O	1	S
Vespertilionidae	*Chalinolobus nigrogriseus*	Hoary Wattled Bat	D	2	MI, S
Vespertilionidae	*Miniopterus australis*	Little Bent-wing Bat	H, D	3	MI, S
Vespertilionidae	*Miniopterus schreibersii*	Common Bent-wing Bat	D	2	MI, S
Vespertilionidae	*Myotis adversus*	Large-footed Myotis	D	2	MI, S

Table 2. Survey effort, species and habitat recorded for predator scats (S), elliott (E) and cage (C) trapping. * indicates an introduced species. Refer to Figure 1 for site localities and Study Area section for description of habitat types.

Site	S	E1	E2	E3	E4	E5	C1	C2	C3	P1	P2	P3
Habitat	S	MI	S	S	S/MI	B	MI	MI	S/M	S	S	B
AMPHIBIANS												
Limnodynastes ornatus	—	—	—	—	—	—	—	—	—	0	2	0
*Bufo marinus**	—	—	—	—	—	—	—	—	—	5	7	1
REPTILES												
Carlia storri	—	—	—	—	—	—	—	—	—	1	1	0
Carlia vivax	—	—	—	—	—	—	—	—	—	0	1	0
Cryptoblepharus littoralis	—	—	—	—	—	—	—	—	—	0	1	0
Crytoblepharus virgatus	—	—	—	—	—	—	—	—	—	1	0	0
Ctenotus taeniolatus	—	—	—	—	—	—	—	—	—	1	0	1
Lygisaurus aeratus	—	—	—	—	—	—	—	—	—	2	0	2
Nactus pelagicus	—	—	—	—	—	—	—	—	—	0	1	0
Rhinoplocephalus nigrescens	—	—	—	—	—	—	—	—	—	1	0	0
MAMMALS												
Melomys burtoni	1	0	8	5	3	15	0	0	0	1	1	1
Uromys caudimaculatus	—	1	0	0	1	1	0	0	2	0	0	0
Trap-nights		30	60	80	60	45	12	15	12	20	15	15
Success/100 trap-nights		3.3	13.3	5	6.6	35.5	0	0	16.6	60	70	33.3

species or species present in low densities are often only detected in longer term surveys in some cases over many years.

Amphibians

Amphibians are not typically associated with marine and coastal habitats, due to their intolerance of saline environments (Hutchings and Saenger 1987). Therefore it was not surprising that no amphibians were recorded in the mangrove and intertidal areas. Six species were recorded from the sand dune ridge and eucalypt woodland habitat, all of which are common and typical of these drier communities (e.g., the burrowing frogs, *Limnodynastes convexiusculus, L. ornatus*) or disturbed habitat close to urban areas (e.g., the treefrogs, *Litoria nasuta, L. alboguttata*). These areas provide important habitat refuges for amphibians in an otherwise unsuitable coastal environment. The Cane Toad *Bufo marinus* was ubiquitous and abundant in all of these non-marine habitats, particularly the tracks and disturbed habitat.

Reptiles

The reptile fauna of the study area can be divided into two groups: (a) the aquatic or semi-aquatic species that are entirely restricted to the mangrove and intertidal habitats; and (b) the terrestrial species that are restricted to the sand dune ridge and woodland habitats, but may forage in the mangrove forest.

Surveys for aquatic reptiles (turtles, snakes) were not conducted; however, the Queensland Museum records four species of sea snake and one file snake for the study area. Sea snakes commonly occur in estuarine and mangrove areas (Hutchings and Recher 1982; Hutchings and Saenger 1987). Though specific habitat preferences for many species are largely unknown, distribution is thought to reflect the occurrence of prey items such as fish and marine invertebrates (Heatwole and Cogger 1993). Those species recorded for the study area most commonly associated with coral reef habitats (*Aipysurus* spp.) and the open water (*Astrotia stokesii, Pelamus platurus*) probably represent dead animals washed onto the beaches. The Little File Snake *Acrochordus granulatus* is also widely distributed throughout marine and estuarine environments, but prefers mangroves habitats where it actively forages for benthic goboid fish (Shine and Houston 1993).

The Green Turtle *Chelonia mydas* and the Saltwater Crocodile *Crocodylus porosus* are both occasionally recorded from the seagrass beds, mangroves and estuaries in the area (Hutchings and Saenger 1987; TIMP 1992), though both have declined in numbers due to habitat disturbance as a consequence of the proximity to Cairns (TIMP 1992).

The high number of the terrestrial reptiles recorded (18 spp.) reflects the combined availability of supra-littoral habitat and productive mangrove forest for foraging. The small scinid, agamid and gekkonid species recorded were all restricted to, and would generally only utilize, the sand ridge and woodland habitats. Conversely the larger, wide-ranging predatory species (the Sand and Lace Monitors *Varanus gouldii, V. varius*, Amythestine Python *Morelia amethistina*, Keelback snake *Tropidonophis mairii*) would venture into the mangroves at low tide, feeding on large invertebrates, fish, birds, flying foxes and carrion (Hutchings and Saenger 1987). Two other python species not recorded in the present survey, but typical of coastal wetland and mangrove habitats in the region include the Olive Python *Liasis fuscus*

and the Carpet Python *Morelia spilota*. These large predators are often attracted to mangroves by the large camps of flying foxes on which they feed (Hutchings and Recher 1982; Hutchings and Saenger 1987).

Birds, Excluding Shorebirds

The high number of bird species (84 spp.) recorded in such a short survey reflects the range of available habitat types (intertidal to woodland). An ongoing census of birds in the study area has to date recorded a further 57 species (CPA unpublished data). The mosaic of habitat types provides a wide and cross-seasonal supply of feeding and nesting resources for a range of resident, migratory, terrestrial and aquatic bird groups. A number of specific features of the bird communities and habitat contributing to this pattern of species richness can be identified.

Mangrove Endemism

Tropical mangroves of northern Australia are relatively rich in endemic mangrove bird species. Fourteen species are virtually restricted to mangroves and twelve utilize mangroves as primary habitat in part of their range (Ford 1982; Hutchings and Recher 1982; Hutchings and Saenger 1987; Noske 1996). Many of these were recorded during the present survey including the Collared Kingfisher, Striated Heron, Little Bronze-cuckoo, Mangrove Gerygone, Large-billed Gerygone, Mangrove Robin, Varied Honeyeater, Black Butcherbird, Helmeted Friarbird and Shining Flycatcher. Specializations of these species to mangrove habitat include the preference for closed canopy habitats with a warm mesic and protected environment and the dependence on particular kinds of food (e.g., intertidal invertebrates, mangrove blossoms, certain terrestrial invertebrates). A more recent survey of bird assemblages in mangrove forest in the Northern Territory identified 11 mangal-dependent species and a total of 17 confirmed and five probable breeding residents (Noske 1996). In addition, many species exhibited a strong associations with particular mangal zones (Noske 1996).

Mangroves as Secondary, Seasonal Habitat

Sixty bird species have been recorded using mangrove regularly or seasonally (Ford 1982; Hutchings and Saenger 1987). Features of mangrove vegetation utilized by these bird species include: the food resources (nectar, invertebrates) associated with flowering mangroves or the inter-tidal substrate (e.g., Rainbow Lorikeet, Yellow-spotted, Brown, Graceful, Dusky Honeyeaters, Figbird, White-faced Heron, Intermediate Egret, Black Bittern); sheltered breeding sites (e.g., Australian White Ibis, Pied Imperial Pigeon); and habitat as refuge during migration, winter and drought (e.g., Yellow Oriole, Metallic Starling, Spangled Drongo, Rainbow Bee-eater, Dollarbird) (Blakers *et al.* 1984; Hutchings and Recher 1982; Hutchings and Saenger 1987; Noske 1996). The proximity of other terrestrial habitat (e.g., woodland and sand ridge communities) that would act as primary habitat for these species is an important feature for the presence of these species in a predominantly intertidal and wetland environment.

Shorebirds

Shorebirds are commonly associated with coastal and intertidal wetlands. In Australia there are 15 species that are resident, 36 regular migrants and 16 vagrants (Watkins 1993). Cairns is located on one of the major migratory pathways for shorebirds that breed in the Arctic (Lane 1987) and it is estimated that 17 species utilize Trinity Inlet regularly and a further 29 occasionally (TIMP 1992). Though targeted surveys for shorebirds or migratory waders was not a primary aim of the current survey, six species were recorded incidentally during bird census and active searching activities. An ongoing survey in and around the Cairns Airport has to date recorded a further 16 species (CPA unpublished data).

Coastal wetland systems such as those found in the study area act as an important staging areas and over-wintering sites. In addition, the array of habitats and the productive mangrove and intertidal environment are significant contributors to shorebird diversity given the propensity for different species to exhibit foraging and roosting zonation within the coastal environment (Lane 1987).

Non-volant mammals

The non-flying mammals are the least conspicuous and abundant species group recorded in the study area. Rodents were the dominant species group with three species recorded: the White-tailed Rat *Uromys caudimaculatus*, the Water Rat *Hydromys chrysogaster* and the Grassland Melomys *Melomys burtoni*. The first two species are likely to forage widely in all habitats, while the Grassland Melomys, along with another three mammal species recorded, (Echidna *Tachyglossus aculeatus*, Agile Wallaby *Macropus agilis* and Sugar Glider *Petaurus breviceps*), are restricted to the sand dune ridges and the mangrove margins.

Other species expected in the study area and recorded as periodically using mangroves include the Canefield Rat *Rattus sordidus*, Fawn-footed Melomys *Melomys cervinipes*, Northern Brown Bandicoot *Isoodon macrourus*, the Brush-tailed

Figure 4. The Little Bent-wing Bat *Miniopterus australis*, a common microchiropteran bat in coastal and near-coastal northeastern Australia. It roosts in caves and tunnels during the day, foraging in rainforest, *Melaleuca* swamps, woodlands and mangroves. This bat was the most abundant species recorded during the current survey. Photo by Alex Kutt.

Possum *Trichosurus vulpecula* and the Swamp Wallaby *Wallabia bicolor* (Hutchings and Recher 1982; Hutchings and Saenger 1987). All of these species would also preferentially utilize the sand ridge and woodland communities as primary habitat.

Volant mammals

Both megachiropterans and microchiropterans are known to utilize coastal wetlands and woodlands (Hutchings and Saenger 1987). Three species of flying fox, the Grey-headed *Pteropus poliocephalus*, the Little Red *P. scapulatus* and the Black *P. alecto*, commonly roost in mangroves or feed on mangrove blossoms (Hutchings and Saenger 1987; Wallace 1992). Camp sizes may number between 1 000 and 10 000 individuals consisting of a number of species (Wallace 1992). Mangroves and coastal wetlands are also known to be significant feeding areas for the Common Blossom-bat *Syconycteris australis* (Law 1993) and the Northern Blossom-bat *Macroglossus minimus* (Start and Marshall 1976). Black Flying foxes were occasionally seen flying over the study area, but no roost colonies were located.

The biology and distribution of microchiropteran bats in coastal wetlands is poorly known due to the lack of survey for these mammals. During the present survey, six species of bats were recorded. On one evening of ultrasonic detecting in mixed *Ceriops tagal, C. decandra, C. australis* mangrove forest, large numbers of bats, consisting of four species *(Miniopterus australis, M. schreibersii, Mormopterus loriae, Chalinolobus nigrogriseus)* were observed foraging over and beside the vegetation canopy. It was estimated that over 50 individuals were foraging in an area of approximately 200 m × 50 m. In addition, over two nights of harp trapping in a flyway on the boundary of sand dune ridge and mangrove habitat, 48 individual *Miniopterus australis* were captured (Fig. 4).

This apparent abundance of bat species in the mangroves of the study area is perhaps not surprising. Though mangrove productivity is mostly discussed in terms of its contribution to intertidal and estuarine environments, the abundant terrestrial and flying invertebrates (spiders and insects) utilizing or spending part of their life cycle in mangrove forest is also high (Graham *et al.* 1975; Hutchings and Saenger 1987). This rich food source, combined with the potentially large number of roost sites in the woodland tree species found on the adjacent sand ridge habitat, provides a highly suitable environment for insectivorous bats.

As an illustration of the potential diversity of mangal bat assemblages, McKenzie and Rolfe (1986) identified five foraging guilds comprising of up to fifteen species regularly utilizing mangrove forest in the Kimberley, Western Australia. They recorded up to eight species utilizing a single stand, with the assemblage of species always showing no overlap of foraging niche (identified by flight morphology), even though significant overlap was possible from the pool of potential colonizers.

CONCLUSION

This short survey of wetland habitat surrounding the Cairns International Airport (CIA) has highlighted its significance for a range of coastal terrestrial fauna assemblages in northern Australia, particularly for groups less often examined such as reptiles, bats and non-volant mammals (Graham *et al.* 1975; Hutchings and Recher 1982; Hutchings and Saenger 1987). A number of general environmental features of these and other coastal wetland habitats can be identified:

- a coastal wetland habitat mosaic (comprising of mangrove forests, sand dune woodland, beach dune shrubland, closed forest, estuarine environments, saltmarshes, tidal mudflats, seagrass beds and open waters) provides a diverse array of both primary and secondary roosting, breeding and foraging habitat for a wide range of terrestrial fauna;
- remnant coastal wetland habitat provides an important refuge for native fauna, particularly in urban and associated developed areas; and
- in tropical northern Australia, coastal habitat and associated watercourses act as important links between intertidal and inland terrestrial habitat, and as long-shore corridors, staging areas or over-wintering sites for mobile and migratory aquatic and semi-aquatic species.

Long-term fauna survey and monitoring of the mangrove/sand ridge habitat mosaic surrounding the CIA has been commissioned by the Cairns Port Authority and will commence in

the near future. These additional data should provide valuable information for the ongoing management of this complex and important coastal wetland area.

ACKNOWLEDGEMENTS

This study was commissioned and funded by the Cairns Port Authority as part of a larger Environmental Baseline Survey of the coastal wetlands surrounding the Cairns International Airport and sincere thanks go to Jannine Cowan for supervision and support of the survey. I would also like to thank Assoc. Prof. Richard Pearson (ACTFR), Brad Law (CSIRO, Atherton) and Dan Lunney (NSW NPWS) for comments on the draft manuscript. Barbara Triggs (c/- "Dead Finish", Genoa, Vic. 3891) analysed the predator scat hair samples. All trapping was conducted under the terms and conditions of the Queensland National Parks and Wildlife Service permit to take fauna no. T-01182.

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